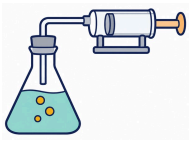
Rates and Rate Equations Map

AQA A-level Chemistry (7405) · 3.1.9 Rates and rate equations

1 Measuring a rate

3.1.5.3, RP 7

- Rate = change in concentration ÷ time
- Unit: **mol dm^{-3} s^{-1}**
- Gas volume, mass loss, **colorimetry**
- Titrate **quenched** samples



2 Rate equations

3.1.9.1 i-iv

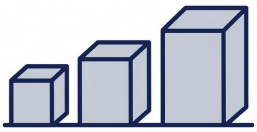
- rate = **k[A]^m[B]^n**
- Orders 0, 1 or 2: **from experiments**
- Overall order = m + n
- k fixed at one temperature

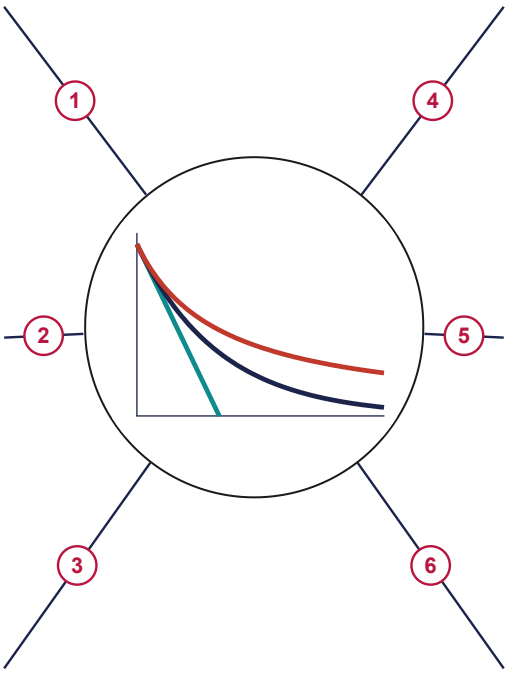


3 Units of k

3.1.9.1 iv

- Zero: mol dm^{-3} s^{-1}
- First: **s^{-1}**
- Second: dm^3 mol^{-1} s^{-1}
- Third: dm^6 mol^{-2} s^{-1}

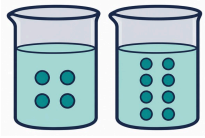




4 Initial rates

3.1.9.2 iv-v

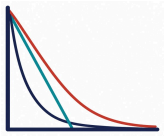
- Change **one** concentration only
- Double it: rate × 1, × 2, × 4
- Clock reaction: rate ∝ **1/t**
- Same total volume: water



5 Graph shapes

3.1.9.2 ii, iv

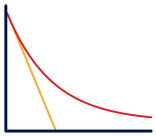
- [A]–time: zero is a **straight line**
- Rate = gradient of the **tangent**
- Rate–[A]: flat, straight, curve
- First order: gradient = k



6 Initial rate from data

3.1.9.2 iii

- First readings of one run
- **Tangent at t = 0**
- Early chords run a little low
- Compare runs: the order



Orders at a glance

one reactant A; doubling [A] at constant temperature

Order	Rate equation	Unit of k	[A]–time graph	Rate–[A] graph	Double [A]
0	rate = k	mol dm^{-3} s^{-1}	straight line	horizontal line	× 1
1	rate = k[A]	s^{-1}	curve; tangents ∝ [A]	straight, through 0	× 2
2	rate = k[A]^2	dm^3 mol^{-1} s^{-1}	curve, flattens sooner	upward curve	× 4

Worked examples

Order from a table

- [B] × 3, rest the same
- rate × 9 = 3^2
- **second order** in B

k from a tangent

- rate 4.0 × 10^{-4} at [A] 0.080
- first order: k = rate ÷ [A]
- **5.0 × 10^{-3} s^{-1}**

Clock times

- [I$^-$] × 2: t 48 s → 24 s
- 1/t doubles
- **first order** in I$^-$

Rate equations lead on to the rate-determining step and to the Arrhenius equation (3.1.9 Mechanisms and temperature).

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